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Expectations, Policy Shocks, and Output Behaviour in a Multi-Country Macroeconomic Model

by

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Abstract

This paper examines the relationship between policy initiatives to stimulate aggregate demand, economic activity, and the way economic agents form expectations. Specifically, we perform simulation exercises on the Canadian block of a linked international model (INTERMOD) with a relatively transparent theoretical structure that can be parameterized to incorporate either adaptive or model-consistent expectations. The behavioural relationships in the model are neoclassical in flavour and incorporate a fully-specified relationship between fiscal policy, wealth, and private-sector consumption. Nevertheless, the model is not policy-neutral -- aggregate demand shocks generate output fluctuations because of overlapping contracts in labour markets. The simulation results confirm the "traditional" view that, when expectations are forward-looking in the sense of being consistent with the model's predictions of future variables, the response of output to fiscal initiatives is smaller than when expectations are based only on past experience. These results contrast with those of Dungan and Wilson (1988), who observe that ". . . the FOCUS model with consistent expectations has policy multipliers **larger** than the standard version of the model" (p. 58). On the other hand, in INTERMOD monetary policy has a more powerful impact effect on real output when expectations are model-consistent, as the exchange rate "overshoots" its equilibrium level in response to a monetary stimulus.

RÉSUMÉ

Ce document traite des rapports entre les politiques de stimulation de la demande globale, l'activité économique, et le processus de formation des attentes des agents économiques. Plus particulièrement, nous effectuons des simulations avec le volet canadien d'un modèle international (INTERMOD) dont la structure théorique relativement transparente peut être spécifiée de façon à refléter soit des attentes adaptatives, soit des attentes conformes aux prédictions du modèle. Les relations de comportement dans le modèle sont de type néoclassique et incorporent la politique financière, la richesse et la consommation du secteur privé. Néanmoins, le modèle a des propriétés de non-neutralité à court terme face à des politiques discretionaires: les variations de la demande globale entraînent des fluctuations de la production en raison du chevauchement des contrats sur les marchés du travail. Les résultats des simulations confirment ce que l'on croit habituellement à savoir -- lorsque les attentes sont tournées vers l'avenir, c'est-à-dire qu'elles sont conformes aux prédictions du modèle, la production réagit moins à la politique fiscale que si les attentes sont de nature adaptative, c'est à dire basées sur l'expérience passée. Ces résultats sont contraires à ceux de Dungan et Wilson qui, en 1988, ont constaté que lorsque les attentes sont en accord avec le modèle, les multiplicateurs du modèle FOCUS sont <u>plus élevés</u> que dans la version standard du modèle. Par ailleurs, dans le cas d'INTERMOD, la politique monétaire influe davantage sur la production réelle lorsque les attentes sont établies en fonction d'un modèle, car le taux de change dépasse le niveau d'équilibre en réponse à stimulus monétaire.

1. Introduction

This paper discusses the macroeconomic effects of policy shocks in the context of a forward-looking model of the major industrial economies and the rest of the world. We are principally interested in the extent to which fiscal and monetary policies influence real output over the short- and medium-run horizon, and how their impact depends on the assumed expectations-formation process. In particular, theoretical considerations suggest that the effect of fiscal shocks on real variables is attenuated the more forward-looking are the expectations of private-sector agents. On the other hand, a recent study by Dungan and Wilson (1988) using an empirical model of the Canadian economy (FOCUS) reaches the opposite conclusion -- fiscal multipliers are higher when agents' expectations are consistent with actual model outcomes as opposed to when expectations adjust gradually over time. One troubling implication of this result is that a sustained fiscal contraction will have a greater effect on real output if fiscal policy is initially perceived to be "credible" than if agents behave as though the policy were transitory.

This paper takes another look at the impact of policy shocks in a model of the industrial economies and the rest of the world (INTERMOD) that can be explicitly parameterized to reflect either model-consistent or adaptive expectations.[1] Our principal conclusion confirms the "conventional wisdom" that forward-looking expectations reduce the effect on real output of aggregate demand shocks in the form of government spending increases or tax cuts. On the other hand, money level or growth shocks have a greater impact on output when expectations are forward-looking, largely because of exchange rate movements.

We then compare our results to those obtained by Dungan and Wilson (henceforth DW), paying particular attention to the role of the length of the simulation horizon, fiscal feed-back rules, and the degree of international asset substitutability in affecting the results. We find that the first two factors are relatively unimportant. However, imperfect asset substitutability can play an important role in the transmission of fiscal shocks: a sufficiently low degree of international asset substitutability causes an exchange rate depreciation in response to a positive shock to domestic spending that can be reinforced by forward-looking expectations. In an economy with a large traded-goods sector such as Canada's, this effect can be large enough to reverse the earlier conclusion about model-consistent versus adaptive expectations. Nevertheless, we believe that this view of the world is less plausible than one where there is a high degree of asset substitutability -- other explanations exist for negative reactions in exchange markets to expansionary fiscal policy.

The next section of the paper discusses the specification of the model used to perform the policy shocks. We focus primarily on the channels of transmission from policy instruments to aggregate output, emphasizing the role

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[1] The term "model-consistent" indicates that expectations are generated using the predicted values from the model itself. This may or may not be "rational", in that expectations are specific to a particular model structure and no attention is paid to costs of processing information.

played by different expectations-formations mechanisms. Section 3 presents simulation results for four policy shocks on the Canadian block of the model: an increase in real government expenditures, a cut in taxes, a money level shock, and a money growth shock. The fourth section of the paper compares our results with those obtained by DW and explores some of the reasons for the differences. The last section summarizes the results.

2. Description of the Model

The policy shocks in this paper have been performed using the Department of Finance's model of linked international economies (INTERMOD). This model is based on a similar model developed at the IMF (MULTIMOD), as documented in Masson et al. (1988). The original Finance variant of this model is described in Helliwell et al. (1988), while work that has been undertaken since that time is summarized in Boileau et al. (1989). The simulations discussed in this paper are based on recent changes to the model involving the specification of consumption, wealth and investment that introduce forward-looking expectations to real as well as financial variables.

The development of MULTIMOD and INTERMOD has been motivated by several problems with conducting model-consistent simulation exercises in traditional macroeconomic models: ad hoc behavioural relations, expectations processes that are often not explicitly defined, computationally-expensive simulations using quarterly data, relatively short simulation horizons, and unknown steady-state properties. In contrast, INTERMOD is designed specifically for policy-simulation exercises. The structure of the representative country block is compact, the behaviourial relations are derived from optimizing behaviour, stock-flow relationships are respected, and expectations are explicitly modelled to facilitate the use of different expectations processes. The annual frequency of the model simplifies its dynamic structure, reduces computational costs, and permits the use of long simulation horizons to verify the convergence of the model to steady-state growth paths following policy shocks.

Both INTERMOD and MULTIMOD disaggregate the industrial countries into the individual G-7 countries plus the aggregate of the 11 smaller industrial countries, for a total of eight industrial-country blocks. These blocks have, with limited exceptions, an identical structure and common parameters. The parameters have, for the most part, been estimated over the historical period using either pooled or single-equation estimation techniques for the industrial countries. The most important differences between the country blocks are their external sectors, and in particular their degree of openness, their patterns of trade, and some of the trade elasticities. The Rest of the World block is divided into two regions: high-income oil exporters and the developing countries. The most important difference between INTERMOD and MULTIMOD from the point of view of the current exercise is the specification of expectations: MULTIMOD employs only model-consistent expectations, whereas INTERMOD can be parameterized to reflect either adaptive and model-consistent expectations. The purpose of this section is to provide a brief overview of the specification of the typical industrial-country block of the model with an emphasis on the expectations-formation process.

2.1 Aggregate Demand

The level of disaggregation on the demand side of the model is consistent with the familiar national-income accounting identity:[2]

$$GDP = C + I + G + (X - M) . \qquad (2.1.A)$$

Separate behavioural equations are specified for consumption, investment, and the components of the trade balance, while real government expenditures are an exogenous policy variable. Here we pay particular attention to the specification of the consumption function given its role in determining the effects of fiscal shocks on aggregate demand.

2.1.1 Consumption and Wealth

The specification of consumption and wealth is a critical determinant of the impact of fiscal policy on aggregate demand. As is well known from the literature stimulated by the work of Barro (1974), in forward-looking models where households have the same discount rate and planning horizon as the government, deficit-financed tax cuts result in an exactly offsetting "jump" in perceived future tax liabilities, leaving wealth, consumption, and aggregate demand unchanged.[3] In addition to the extent to which the present value of future tax liabilities is fully recognized by households, the impact of government spending changes depends on the substitutability of public and private spending in the representative household's utility function and the expected duration of the spending shock -- if the two are perfectly substitutable or the shock is permanent, there will be no effect on aggregate demand.

Both casual empiricism and conceptual considerations suggest that fiscal policy has more wide-reaching impacts than indicated by "full" Ricardian equivalence. In models where agents are permitted to make systematic expectational errors, it is relatively easy to generate more powerful fiscal multipliers by basing expected wealth only on current and lagged disposable income. However, it requires more care to construct a forward-looking model that explicitly incorporates deviations from full Ricardian equivalence in the structural relationships. The consistent-expectations version of INTERMOD can

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[2] All real variables in the model are indexed such that implicit deflators in national currency units equal unity in 1980.

[3] The distortionary effects of non-lump-sum taxes on real output are not included in the model. It could be argued that wealth should fall given a temporary tax cut offset by future tax increases, as the impact of distortionary taxes is generally proportional to the square of the tax rate.

be viewed as taking Ricardian equivalence as a starting point, in that wealth is defined to be the discounted value of the future stream of after-tax real net domestic product plus the initial-period stock of financial assets.[4] Nevertheless, INTERMOD embodies two deviations from the Ricardian assumptions that explain why private-sector consumption rises in response to a tax cut:

1. We assume that the economy consists of two types of households -- those that have full access to credit markets, and those who have no access to credit markets. The first group of households are "wealth-constrained" while the second are "income-constrained"; the proportion of total households that is income-constrained is allowed to decay over time in response to a shock.

2. Following the work of Blanchard (1985), the discount rate for households that have access to credit markets is equal to the real rate of interest plus the probability of death.[5]

In addition, a government spending increase that is fully tax-financed in the initial period will raise aggregate demand for two reasons:

1. Private-sector consumption does not respond instantaneously to changes in income and wealth, reflecting lags in the adjustment of consumption to its determinants.

2. Private and public spending are not perfect substitutes in the private-sector utility function (indeed, the implicit elasticity of substitution is zero), thus a temporary increase in government spending does not cause a direct one-for-one drop in private consumption.

The following set of equations describes human wealth, total wealth, and consumption under the two expectations regimes:[6]

Consistent human wealth: $WH = WH_{+1}/(1+RBAR+.02) + 0.75*YD$ (2.1.1.A)

Adaptive human wealth: $WH = 0.75*YD/(RBAR+.02-YDDOT)$ (2.1.1.B)

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[4] In the adaptive-expectations version of the model used to perform these shocks, wealth is assumed to be proportional to permanent income, where the latter is a function of current and lagged real disposable income.

[5] In an open economy the probability of emigration should also be included.

[6] While we refer to this as "human" wealth, it includes the return to the domestic physical capital stock and thus is more precisely defined as "non-financial" wealth.

Real disposable income: $YD = (NDP*PGNP - TAX)/P$ (2.1.1.C)

Total wealth: $W = (M+B+NFA*ER)/P + WH$ (2.1.1.D)

Consumption: $\ln(C) = 0.30*\ln(W) + 0.60*\ln(YD) - 0.50*\ln(YD_{-1}) + 0.60*\ln(C_{-1}) - 0.50*RLR$, (2.1.1.E)

where:
- RBAR = equilibrium real interest rate
- 0.02 = probability of death
- 0.75 = proportion of the population that is wealth as opposed to income-constrained in the long run
- YDDOT = equilibrium growth rate of real disposable income
- NDP = net domestic product
- PGNP = GNP deflator
- TAX = taxes less transfers
- P = absorption deflator
- M = high-powered money balances
- B = stock of government bonds
- NFA = net foreign assets in U.S. dollars
- ER = price of domestic currency in U.S. dollars
- RLR = real long-term interest rate.

The adjustment to disposable income of 0.75 in equations (2.1.1.A) and (2.1.1.B) is based on the estimated share of income and consumption attributable to households that are wealth- as opposed to income-constrained in the long run.[7] Under adaptive expectations, human wealth is simply the value of current disposable income capitalized at the equilibrium real interest rate plus the probability of death minus the growth rate of real disposable income. Under consistent expectations, human wealth is the discounted value of the future stream of disposable income, where the discount rate is the equilibrium real interest rate plus the probability of death. While changes in real interest rates do not directly affect human wealth, as future income flows are capitalized at the equilibrium as opposed to the observed real interest rate, there is an independent term in the consumption function that captures the effect of interest-rate changes.[8] Real disposable

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[7] This proportion is consistent with empirical studies using micro data such as that of Hall and Mishkin (1982). It is also supported by data from the Canadian Survey of Family Expenditures for 1986, which indicate that about 30 per cent of consumption spending is by families that have no net savings (not all of these families would be income constrained).

[8] Essentially, the "correct" definition of human wealth would imply a discounting of WH_{+1} in (2.1.1.B) by the observed short-term real interest rate. This expression has been linearized around the equilibrium long-term real interest rate, and the latter has been

income is defined as nominal net domestic product less taxes deflated by the absorption deflator. Total wealth is simply the sum of real human wealth and the real value of domestically-owned financial assets.

The consumption function shown in (2.1.1.E) is linearly homogeneous in the long run in wealth and disposable income, with weights of 0.75 and 0.25 respectively. The weight on disposable income is higher in the short run than the long run, reflecting the hypothesis that the share of income-constrained households declines over time following a shock to the determinants of consumption. In addition to these two factors, the long-run real interest rate enters with a coefficient of -0.5 in the short run (implying that a 100 basis point rise in interest rates reduces consumption by 0.5 per cent), rising to -1.2 in the long run.

2.1.2 Investment

The demand for investment is a variant of the neoclassical approach due to Jorgenson (1963). The long-run equilibrium level of the capital stock is determined by expected output and the user cost of capital. Costs of adjustment mean that the observed capital stock moves gradually to its long-run equilibrium level, with the adjustment speed being determined by the parameter on the lagged capital stock. The user cost of capital is defined conventionally as a function of the expected long-term real interest rate, the depreciation rate of capital, and tax parameters.

In the long run, capital is linearly homogeneous in real output and has a semi-elasticity with respect to the user cost of capital such that a 100 basis point rise in the user cost generates a 0.54 per cent decline in the steady-state capital stock. The difference between the adaptive and model-consistent versions of the investment equation relates to the construction of the target capital stock. Under adaptive expectations, the change in the capital stock is a function of growth in real output and the lagged output-to-capital ratio. In the consistent-expectations version, the lagged output-to-capital ratio is replaced by a five-year moving average of current and future values:[9]

$$\ln(K/K_{-1}) = 0.086*\ln(GDP/GDP_{-1}) - 0.084*UCST + 0.156*QRATIO \quad (2.1.2.A)$$

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included as an independent explanatory variable in the consumption function. This was done for two reasons: to stabilize model dynamics, and to make it easier to directly control the interest elasticity of consumption without a substantially more complicated parameterization of the consumption-wealth relationship.

[9] This variant of the model is based on estimation work undertaken recently at the IMF.

where: K = physical capital stock
GDP = real domestic product
UCST = user cost of capital
QRATIO = $\ln(GDP_{-1}/K_{-1})$ (adaptive)
$\ln((GDP/K + \ldots + GDP_{+4}/K_{+4})/5)$ (consistent).

The result is that, under consistent expectations, current investment behaviour depends on expected future output-to-capital ratios as opposed to historical observations, and thus the response of investment to output changes depends on the future duration and magnitude of the output shock.

2.1.3 Government Sector

Real government spending on goods and services is exogenous in the model, while debt-service payments are determined by the outstanding stock of government bonds and the average of the long- and short-term interest rate. Net taxes (i.e. gross taxes less transfers) are equal to the product of an average tax rate times the level of nominal GDP. There is a fiscal feedback rule in the model such that, over time, the tax rate adjusts to ensure that the ratio of government debt to GDP cannot grow explosively. This reflects the government's intertemporal budget constraint requiring the present value of taxes to equal the present value of government spending plus the initial-period stock of outstanding bonds.

Given the level of government spending and taxes, the instantaneous government budget constraint determines the change in net bonds outstanding as total spending minus net tax receipts minus the change in the monetary base, where the latter is an exogenous policy instrument:

$$(B - B_{-1}) + (M - M_{-1}) = G*P - TRATE*GDP*PGNP + R*B_{-1} , \qquad (2.1.3.A)$$

where: B = outstanding stock of government bonds
M = high-powered money
G*P = nominal government spending
TRATE = average tax rate
R = average interest rate on government debt.

The fiscal feedback rule referred to above adjusts the average tax rate in response to changes in the debt-to-GDP ratio. The rule is parameterized such that the debt-to-GDP ratio stabilizes in about four years after an initial shock to the fiscal balance; the debt-to-GDP ratio then returns to its initial position over a much longer time horizon:

$$TRATE-TRATE_{-1} = 0.3*(BRATGAP_{-1}-BRATGAP_{-2}) + 0.01*(BRATGAP_{-1}) , \qquad (2.1.3.B)$$

where: BRATGAP = difference between the actual and the steady-state target ratio of government debt to GDP.

2.1.4 Trade Sector

Overall trade for the industrial countries is disaggregated into manufactured goods, oil, and imports of primary commodities from the rest of the world. The specification of trade in manufactured goods follows loosely the approach of Samuelson and Kurihara (1980). Import volumes are determined by demand functions that depend on domestic absorption and the price of imports relative to the domestic absorption deflator. In the long run, import volumes are constrained to be homogeneous in absorption, while in the short run "overshooting" is permitted -- a 1 per cent rise in absorption increases Canadian imports by 1.6 per cent in the first year. The long-run relative price elasticity of import demand for Canada is -0.55. Export volumes depend on a share-weighted sum of the import volumes of trading partners and a relative price variable that measures competitiveness in foreign markets -- the long-run relative price elasticity of export demand is -0.84. Export prices are a weighted average of the domestic and foreign GDP deflators, while import prices are a share-weighted sum of trading-partners' export prices.

The current account balance equals total exports less imports plus the investment income flow earned on the stock of net foreign assets. The price elasticities in the trade sector are such that a partial simulation of the trade block generates a first-year "J-curve" effect in response to an exchange rate movement. In the case of Canada, for instance, a 10 per cent depreciation of the dollar versus all other currencies causes a deterioration in the current account balance of 0.2 per cent of GDP in the first year, followed by a 1.2 per cent improvement in the second year -- the long-run effect is a 1.7 per cent improvement in the current account relative to baseline GDP.

The change from one period to the next in the level of net foreign assets (which are all assumed to be denominated in U.S. dollars) is simply the current account balance expressed in U.S. dollars:

$$NFA - NFA_{-1} = CURBALL*ER \ ,$$

where: NFA = net foreign assets in U.S. dollars
CURBALL = local currency current account balance
ER = price of local currency in U.S. dollars .

Net foreign assets are a component of national wealth, as indicated by the equations (2.1.1.A) and (2.1.1.B) above.

2.2 Aggregate Supply

Aggregate supply is summarized by a quasi-reduced-form price equation, where growth in the domestic absorption deflator responds to deviations of output from its potential level, lagged and expected inflation, and changes in the relative price of imports:

$$pdot = 0.5*(pdot_{-1}) + 0.5*(pdot^{e}) + 0.16*CU + (\text{import share})*(pdot^{im}-pdot) ,$$

where: pdot = change in the log of the absorption deflator
CU = two-period moving average of the capacity utilization rate
$pdot^{im}$ = change in the log of the import deflator.

The formal derivation of this equation follows from an overlapping-contracts model of wage-setting behaviour of the type described by Taylor (1979). Other stories are possible, such as that of Cozier (1989) based on quadratic costs of adjusting prices. The sum of the coefficients on lagged and expected inflation are constrained to sum to unity, implying that the Phillips curve is vertical in the long run and output must return to its potential level in the absence of continuing increases in the rate of inflation. The relative weight on lagged and future inflation is a measure of the average contract length -- in INTERMOD this varies across countries, with a typical weight of about 0.5 on both lagged and future inflation. The capacity-utilization term captures the effect on target wage growth of disequilibrium in labour markets, with a one per cent output-market gap corresponding to a 0.16 per cent rise in the rate of inflation holding past and expected future rates of inflation constant. Capacity utilization is defined as the difference between actual and potential output, where the latter depends on the capital stock and a linear time trend representing secular technical progress and growth of the (exogenous) labour supply.

The key difference between the adaptive- and consistent-expectations versions of the model is the specification of expected future inflation -- under adaptive expectations, $pdot^{e}$ adjusts gradually to observed innovations in the rate of inflation, whereas under consistent expectations it is the model outcome for the next-period inflation rate:

adaptive expectations: $pdot^{e} = 0.3*pdot + 0.7*pdot^{e}_{-1}$

consistent expectations: $pdot^{e} = pdot_{+1}$.

2.3 Financial Markets and Monetary Policy

The three key elements of the financial sector in the model are the equations determining: (i) the short-term nominal interest rate through the money-market equilibrium condition, (ii) the long-term nominal and real interest rate through a term-structure relationship, and (iii) the exchange rate through an international arbitrage condition.

Starting with the short-term interest rate, money-market equilibrium is characterized by the inverted money demand function conditional upon a given value for the exogenously-determined stock of high-powered money balances:

$$RS = -0.4 * \ln(M/(P*GDP)) , \qquad (2.3.A)$$

where:
- RS = short-term nominal interest rate
- M = high-powered money balances
- P = absorption deflator
- GDP = real GDP.

The unit coefficient on real GNP in the implicit money demand function implies that the short-term interest rate is directly related to the velocity of circulation of money. A 1 per cent increase in the money supply, holding real output and prices constant, results in a 40 basis point decline in the short-term interest rate.

Under consistent expectations, the long-term interest rate is related to the short-term rate by an explicit term-structure relationship with a maturity of 10 years. Under adaptive expectations, the long-term rate (RL) adjusts gradually to observed innovations in the short-term rate:

$$\text{consistent:} \qquad RL_t = \sum_{i=0}^{9} (RS_{t+i})/10 \qquad (2.3.B)$$

$$\text{adaptive:} \qquad RL_t = 0.33*RS_t + 0.67*RL_{t-1} \qquad (2.3.C)$$

Equation (2.3.B) is a linear approximation to the exact formula for a pure discount bond with a ten-year maturity, where the latter was chosen to correspond to the approximate duration of the actual bond data in the model database.[10] The adjustment speed in (2.3.C) is based on pooled estimation of this equation for the industrial countries. In either case, long-term interest rates move one-for-one with short-term interest rates in the long run. The long-term real interest rate in the consistent-expectations version

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[10] Another consideration was that ten years is the typical cyclical period of the model. Thus the ten-year horizon for the long-bond rate captures a full cycle of short-term interest rates.

of the model is determined by an equation similar to (2.3.B), where the short-term nominal rate is replaced by the real short-term rate defined as the nominal rate less an average of current and next-period inflation rates. Under adaptive expectations, the long-term real interest rate is the nominal rate less a measure of inflation expectations that responds gradually to observed rates of inflation.

The exchange rate equation is based on the arbitrage condition in international capital markets with perfect capital mobility. This implies that the domestic interest rate (adjusted for expected exchange rate movements) must equal the U.S. interest rate. The short-term interest rate is used in conjunction with the one-period-ahead expected change in the exchange rate to give:

$$RS + (ER/ER^{e} - 1) = US_RS \ , \qquad (2.3.D)$$

where: $ER/ER^{e} - 1$ = expected appreciation of the domestic currency
US_RS = U.S. short-term interest rate.

The difference between the two expectations regimes is the construction of ER^{e} -- under consistent expectations it is the one-period-ahead value as predicted by the model, whereas under adaptive expectations it evolves gradually in response to observed exchange rate movements.

3. Policy Shocks and Expectations

In this section we perform four policy shocks on the Canadian block in the model. Specifically, we examine the effects of: (i) a real government spending increase of 1 per cent of GDP, (ii) a decrease in the average tax rate of 2 percentage points, (ii) a 3 per cent money level increase, and (iv) an increase in the money growth rate of 1 per cent per year. The magnitudes of the shocks have been chosen to give roughly comparable impact effects on real GDP. These simulation have been run in "unlinked" mode in the sense that the rest of the world (principally the U.S. in this case) has been held exogenous in order to minimize simulation times. This is relatively unimportant in the case of Canada given our small size in relation to the rest of the world. (The differences are more significant in the case of the U.S., as illustrated by the comparison presented in Appendix A of Canadian and U.S. shocks in INTERMOD run in both linked and unlinked modes.)

The forward-looking simulations are performed using the extended-path algorithm due to Fair and Taylor (1983) using version 13.0 of TROLL. The shocks all start in 1988 (labelled as "88" in the associated output) with a terminal period of 2020. The long simulation horizon has been employed both to reduce the importance of terminal conditions in the consistent-expectations simulations and to verify the convergence of both versions of the model to a post-shock steady state. The shocks are interpreted as surprises to economic agents in the initial period under consistent expectations, with agents then

having perfect foresight as to the future effects of the initial-period shock.[11] The control solution is based on actual historical data for 1988, followed by gradual convergence of real growth and inflation to 2.5 per cent and 3.5 per cent respectively by the mid-1990's. The government deficit and the current account balance converge to values that stabilize ratios of outstanding debt to GDP by 2000.

Before looking at the details of the shocks, it is useful to do some prior theorizing about the effects of different expectations regimes on real output in the model. There is a relatively strong presumption that policy multipliers associated with fiscal shocks will be smaller under consistent expectations than under adaptive expectations. Considering first the financial variables, a shock to domestic spending with an exogenous money supply will tend to generate a sustained increase in short-term nominal interest rates. Under consistent expectations, both long-term interest rates and the exchange rate will "jump" in the initial period to reflect the future path of short rates, leading to a relatively large degree of crowding out of the initial spending shock. The only potential offset is the inflation-expectations term in the long-term real interest rate -- if future inflation rises by more than the short-term interest rate, then it is possible that the long-term real interest rate could fall in the initial period. The response of the short-term interest rate to the price level in the model makes this very unlikely unless the shock generates an explosive increase in the rate of inflation.

The specification of wealth under consistent expectations also reduces the multiplier effects of fiscal shocks, as initial-period changes in disposable income resulting from government spending increases or tax cuts are partially offset by the effect of higher future tax liabilities. In terms of investment, it is not clear that consistent expectations reduce the multiplier given the five-year forward-looking horizon for real output. However, it turns out that this channel is not very powerful, as the initial impact on output decays rapidly over the subsequent four years, and because of the effect on investment of the bigger initial jump in the real interest rate. Finally, real output movements are attenuated under consistent expectations by supply considerations, as the immediate jump in inflationary expectations drives up prices and thus short-term interest rates in the initial period by more than when expectations adjust adaptively.

The features of the model that reduce the impact of fiscal shocks under consistent expectations tend to raise the effect on real output of monetary shocks. This is because the channel of transmission of monetary policy -- i.e. short-term interest rates -- leads to an increased response of other financial variables in the initial period when expectations are model-consistent. In particular, a monetary stimulus that reduces domestic interest rates leads to an immediate downward "jump" in the exchange rate under consistent expectations, as described by Dornbusch (1976): with sticky prices,

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[11] It is also possible to simulate anticipated policy shocks by starting the simulation prior to the period in which the shock occurs, generating "anticipatory recessions" of the type described by DW.

the nominal exchange rate will have to overshoot its new equilibrium level in order to generate the expectation of an exchange rate appreciation to offset lower nominal interest rates on domestic assets. This turns out to be a particularly important channel of transmission of monetary policy under consistent expectations in INTERMOD. The impact of expectations regimes on long-term interest rates is less clear: under adaptive expectations, the long-term rate adjusts only to the initial-period jump in the short rate, while with consistent expectations it equals a 10-year forward moving average of short rates. In practice, a monetary stimulus generates a larger decline in long-term rates under adaptive expectations. Nevertheless, the movement in real long-term rates is about the same, as inflation expectations adjust upwards immediately with consistent expectations.

3.1 Government Spending Shock

The effects on real GDP and the GNP deflator of a permanent shock to real government expenditures of 1 per cent of baseline GDP are shown in Chart 3.1(a). The difference in multipliers between the two versions of the model is quite significant, with real GDP rising by 0.62 per cent under adaptive expectations as opposed to 0.37 per cent under consistent expectations. (Detailed tables on the simulation results are presented in Appendix B.) It is apparent from looking at the initial effect on prices that the short-run supply curve is steeper under consistent expectations -- prices rise by the same amount even though the output change is substantially smaller. It is also clear that the difference in multipliers is not because prices jump by significantly more under consistent expectations.

It turns out that the key difference between the two models in this shock is the response of perceived wealth to changes in government spending. Under consistent expectations, private-sector wealth falls given incorporation of the future tax increases that are required to balance the government's intertemporal budget constraint.[12] In spite of the somewhat higher rate of discount used by the private sector than the government, the decline is significant -- wealth falls by 1.27 per cent compared to the steady-state decline of about 1.5 per cent. On the other hand, perceived wealth under adaptive expectations rises in line with the initial-period increase in real disposable income. The divergent wealth responses are reflected in the behaviour of consumption as shown in Chart 3.1(b). Private-sector consumption is roughly unchanged under consistent expectations, as the effect of reduced wealth is offset by the higher disposable income of income-constrained households. Under adaptive expectations the two effects operate in the same direction, and consumption rises by more than GDP on impact.

The initial response of short-term interest rates shown in Chart 3.1(b) reflects the larger increase in real output under adaptive expectations and the assumption of a fixed money supply. In contrast, the first-year changes

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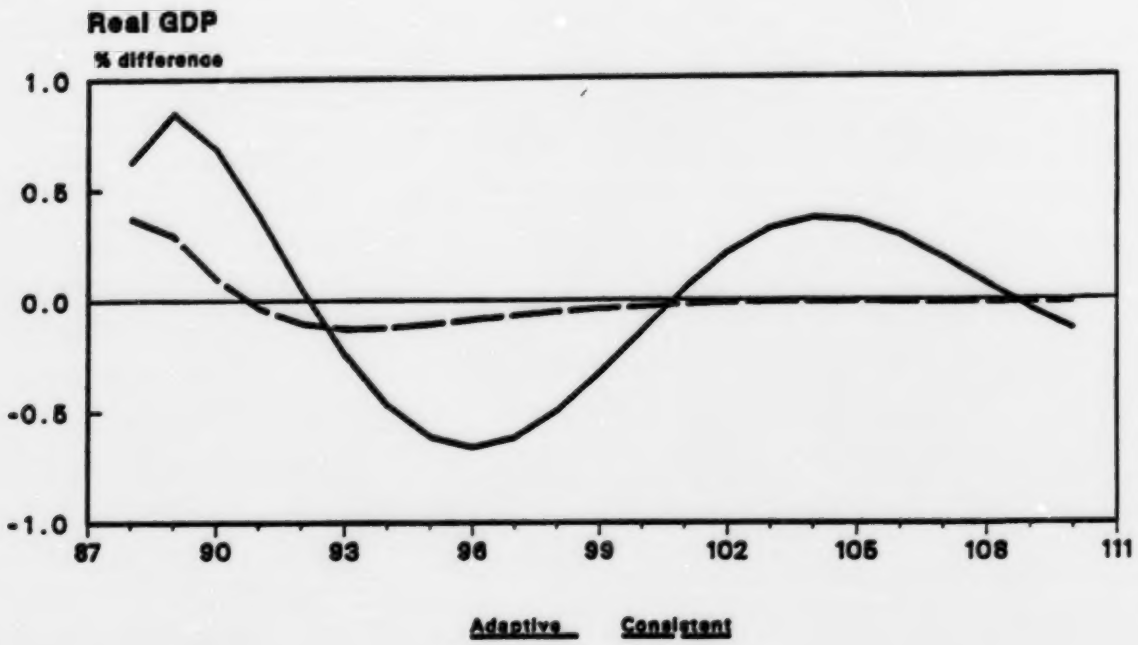
12 The long-run balancing of the intertemporal budget constraint is shown by the convergence of the government deficit to its control solution in the last panel of Chart 3.1(b).

Chart 3.1(a)
Responses to a Permanent Real Government Spending Shock:
1 Per Cent of Baseline GDP



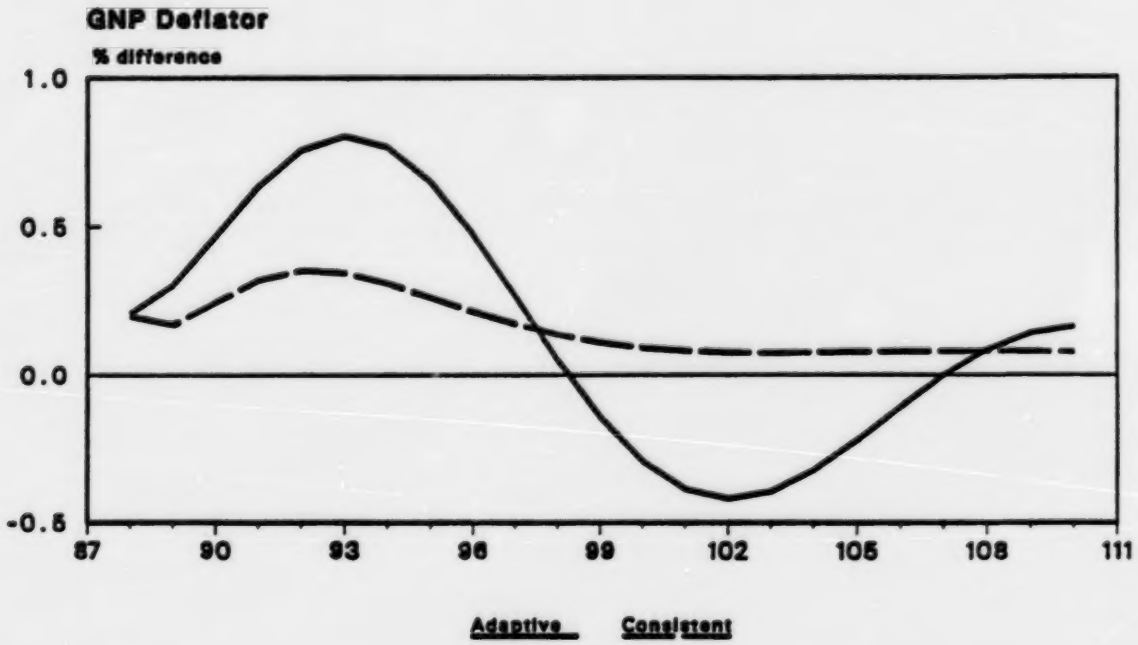
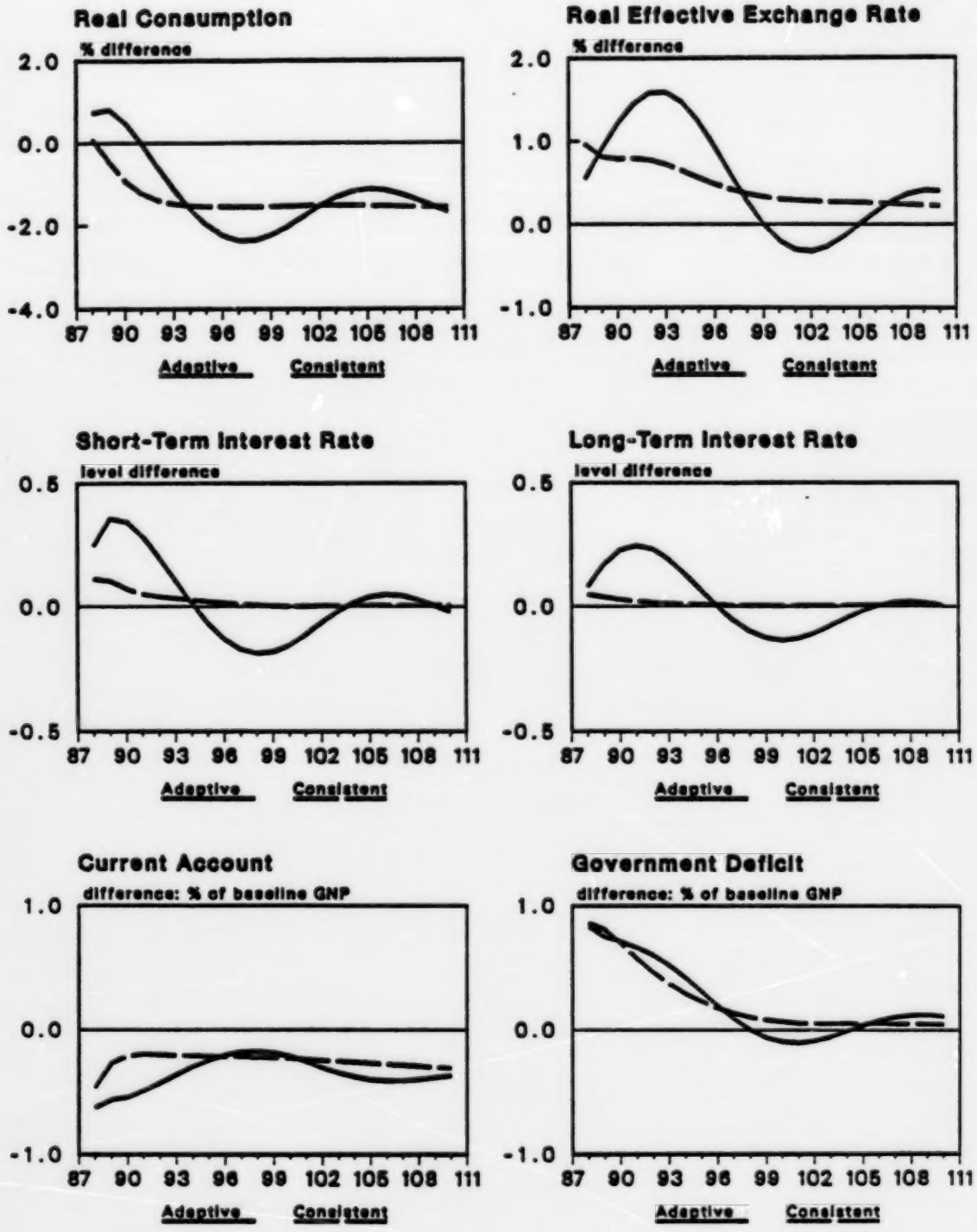


Chart 3.1(b)
Responses to a Permanent Real Government Spending Shock:
1 Per Cent of Baseline GDP



in long-term interest rates are comparable: this is because the effect of the larger movement in the short-term rate under adaptive expectations is offset by the forward-looking nature of the long rate under consistent expectations. The appreciation of the real exchange rate is similar in both cases for the same reason -- the effect of the immediate increase in short-term interest rates is greater under adaptive expectations, but the future path of the short-term interest rate is incorporated in the initial jump in the exchange rate under consistent expectations. It should be emphasized that the exchange rate appreciation follows from the assumption of a high degree of international capital substitutability, implying that the current account deficit that results from the government spending increase can be financed without a large change in the interest differential between domestic and foreign assets (adjusted for expected exchange rate movements). An alternative specification of the capital account is explored in Section 4.

The longer-term cyclical behaviour of the two versions of the model is dramatically different in response to the fiscal shock. Under adaptive expectations, the initial output increase sets in motion a typical Keynesian income-expenditure process that leads to a higher second-year multiplier, and consequently larger increases in the price level. The slow dynamics implied by the adaptive-expectations framework then lead to a long and relatively undamped cycle in output, prices, and the financial variables. This type of long cyclical "echo" in response to an initial shock is typical of simple adaptive-expectations models that have a vertical long-run supply curve. In contrast, the consistent-expectations model exhibits a somewhat shorter cycle and converges relatively quickly to a steady-state solution, as wealth-constrained households dominate consumption spending over time.[13]

3.2 Initial-Period Tax Cut

Tax cuts have a smaller effect in the model than government spending increases on a dollar-for-dollar basis, because they generate no direct increase in aggregate demand -- the effects work through household consumption decisions. Thus a decline in taxes of 2 per cent of GDP is necessary to give roughly the same increase in output as a 1 per cent rise in government spending. The responses of the model are shown in Charts 3.2(a) and 3.2(b). Again, the initial-period impact on real output is almost twice as large under adaptive expectations, while the price response is similar in the two cases.

The response of consumption is closer than in the case of the government spending shock, largely because it is dominated in both cases by the initial rise of 3 per cent in real disposable income. Real wealth rises slightly given the tax cut under consistent expectations (i.e. by 0.1 per cent),

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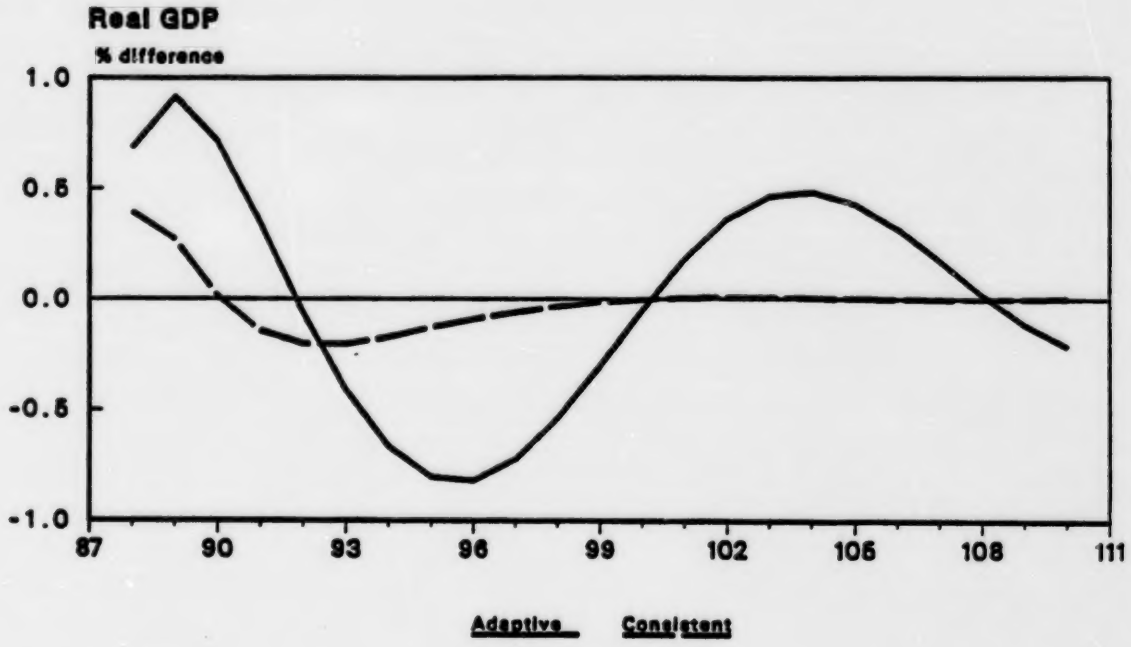
[13] The new equilibrium is not strictly speaking a steady-state growth path, because net foreign assets have not stabilized in relation to GDP by the end of the simulation horizon. The construction of wealth and the parameterization of the consumption function imply that the achievement of a full steady-state in the stock variables will be a rather slow process.

Chart 3.2(a)
Responses to a Transitory Tax Rate Decrease:
2 Percentage Points of Baseline Tax Rate



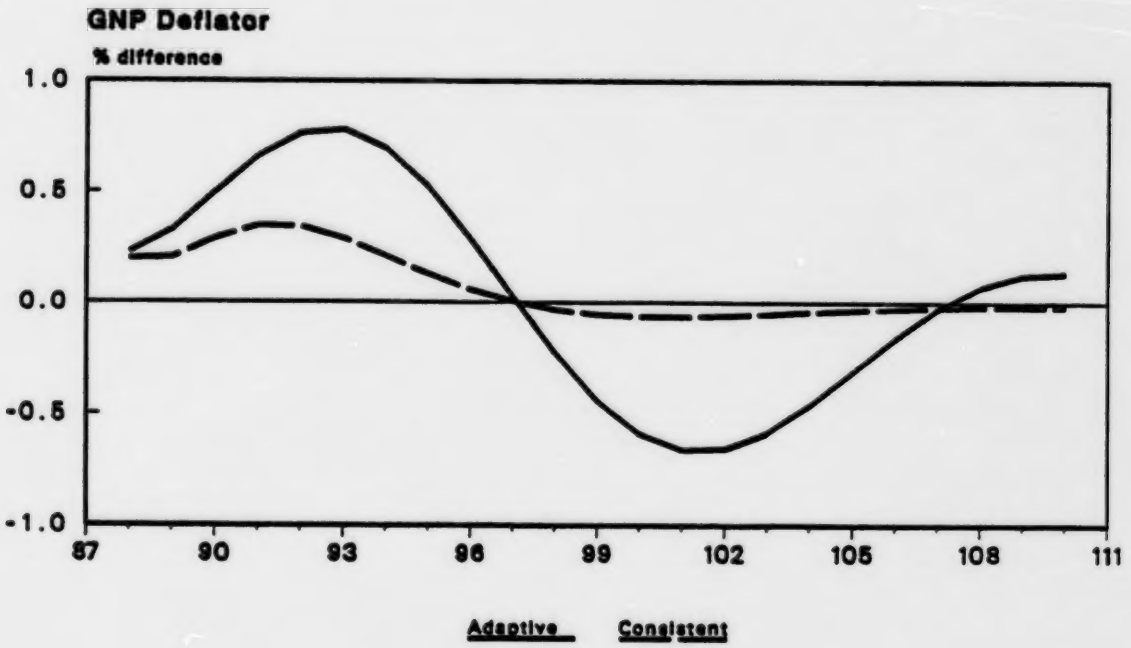
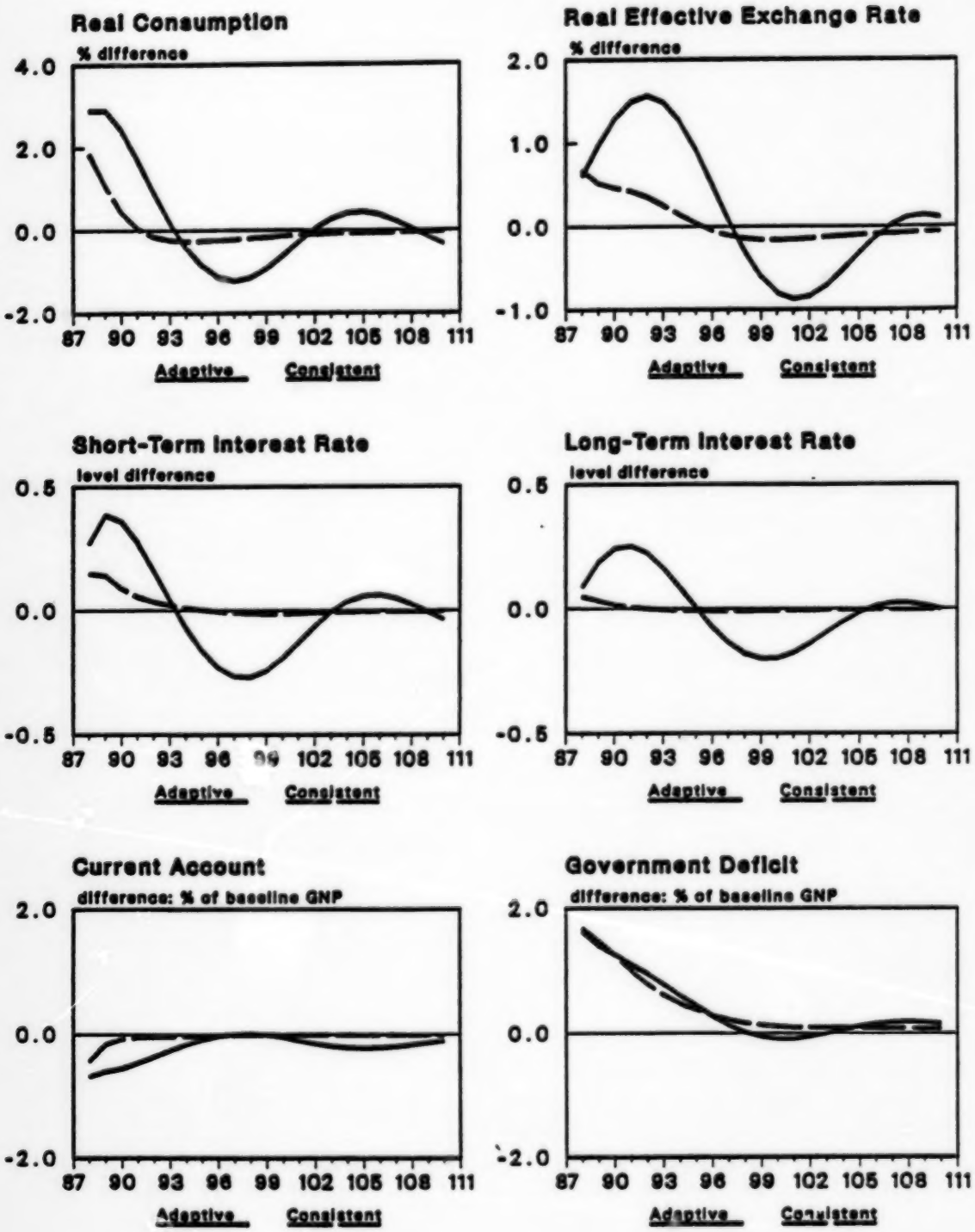


Chart 3.2(b)
Responses to a Transitory Tax Rate Decrease:
2 Percentage Points of Baseline Tax Rate



reflecting the higher discount rate used by the private-sector to value future tax liabilities than enters the government's intertemporal budget constraint. The responses of the financial variables are very similar to those observed for a government spending shock: the increase in the short-term interest rate is higher under adaptive expectations, but the long-term interest rate and the exchange rate move by similar amounts in the two cases. The longer-term cycle also looks very similar to that shown in Charts 3.1(a) and 3.1(b) -- the consistent-expectations version of the model returns quickly to equilibrium whereas the adaptive-expectations version exhibits longer and relatively undamped cycles.

These two fiscal shocks confirm the result typically obtained in theoretical models that forward-looking expectations reduce the impact on output of fiscal shocks. Looked at in a policy context, one implication of this result is that reductions in fiscal deficits that are "credible" in the sense that the private sector incorporates the future effects of the policy in their behaviour have less effect on output than reductions in deficits that are not accompanied by forward-looking behaviour on the part of the private sector.

3.3 Money Level Shock

The effects of a 3 per cent increase in the money supply are shown in Charts 3.3(a) and 3.3(b). Contrary to the results obtained above, the money shock has a higher impact effect on real output under consistent expectations, in spite of the fact that the price level increases by more in the initial period. Looking at the detailed results in Chart 3.3(b), the reason for this result is readily apparent -- the exchange rate depreciation is more than twice as large under consistent than adaptive expectations. The effect of the additional 2 per cent depreciation in the real exchange rate on the real trade balance entirely accounts for the higher output in the initial period, while consumption rises by about the same amount in the two cases.[14]

The overshooting of the nominal exchange rate referred to above can be inferred from the behaviour of the real exchange rate. The nominal rate depreciates by slightly more than the real rate given the increase in the price level; the actual decline in the first period is 3.6 per cent compared to the equilibrium decline of 3 per cent (corresponding to the steady-state rise in the domestic price level resulting from the money supply increase).

After rising slightly in the second year of the shock in response to the

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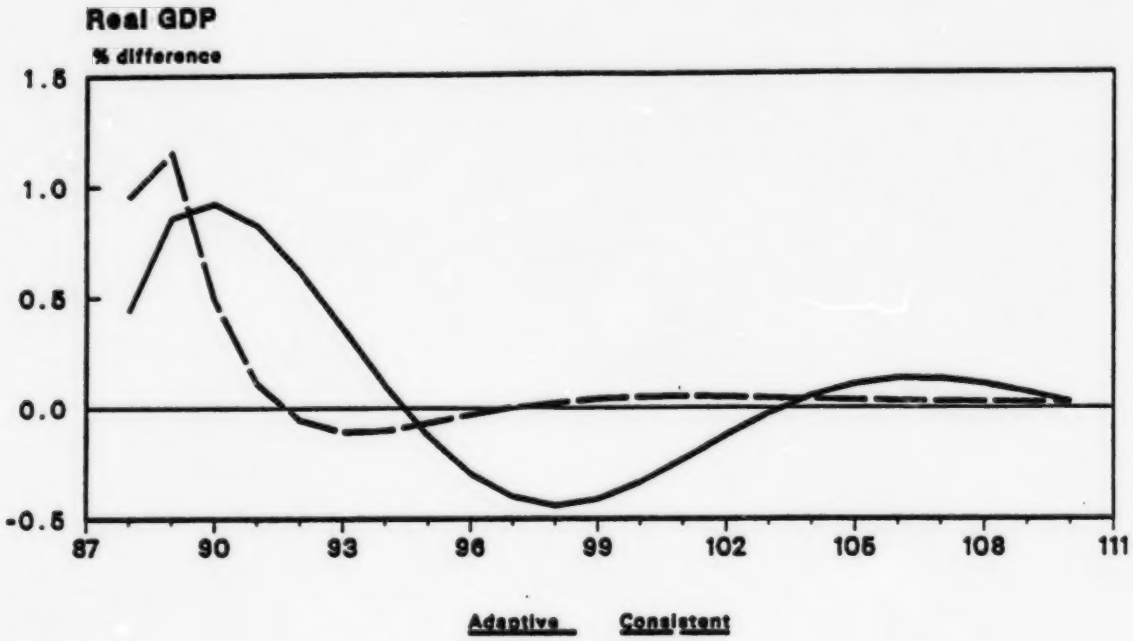
[14] In considering the response of the model to a monetary shock, it is important to recognize that consistent expectations do not increase the responsiveness of prices to output movements or reduce the role of lagged inflation in the price equation. Both of these are a function of the "overlapping-contracts" paradigm that is used to motivate price stickiness in the model. If the average contract length in the model were a function of the expectations regime, then the output response under consistent expectations could be lower than shown here.

Chart 3.3(a)
Responses to a Permanent Increase in the Money Supply:
3 Per Cent of Baseline Money Supply



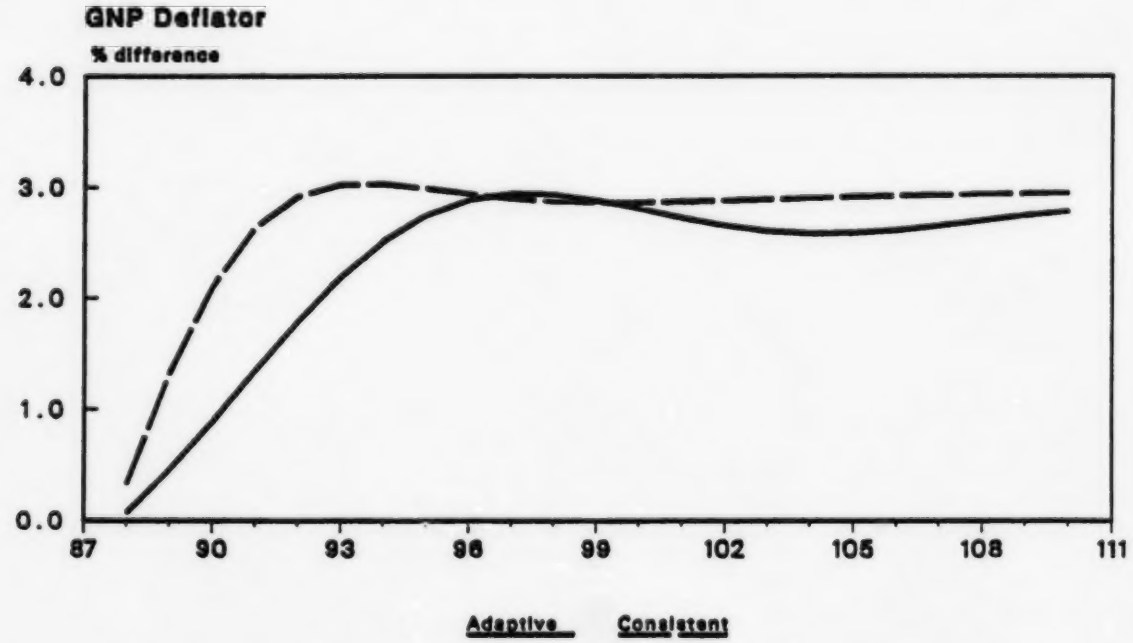
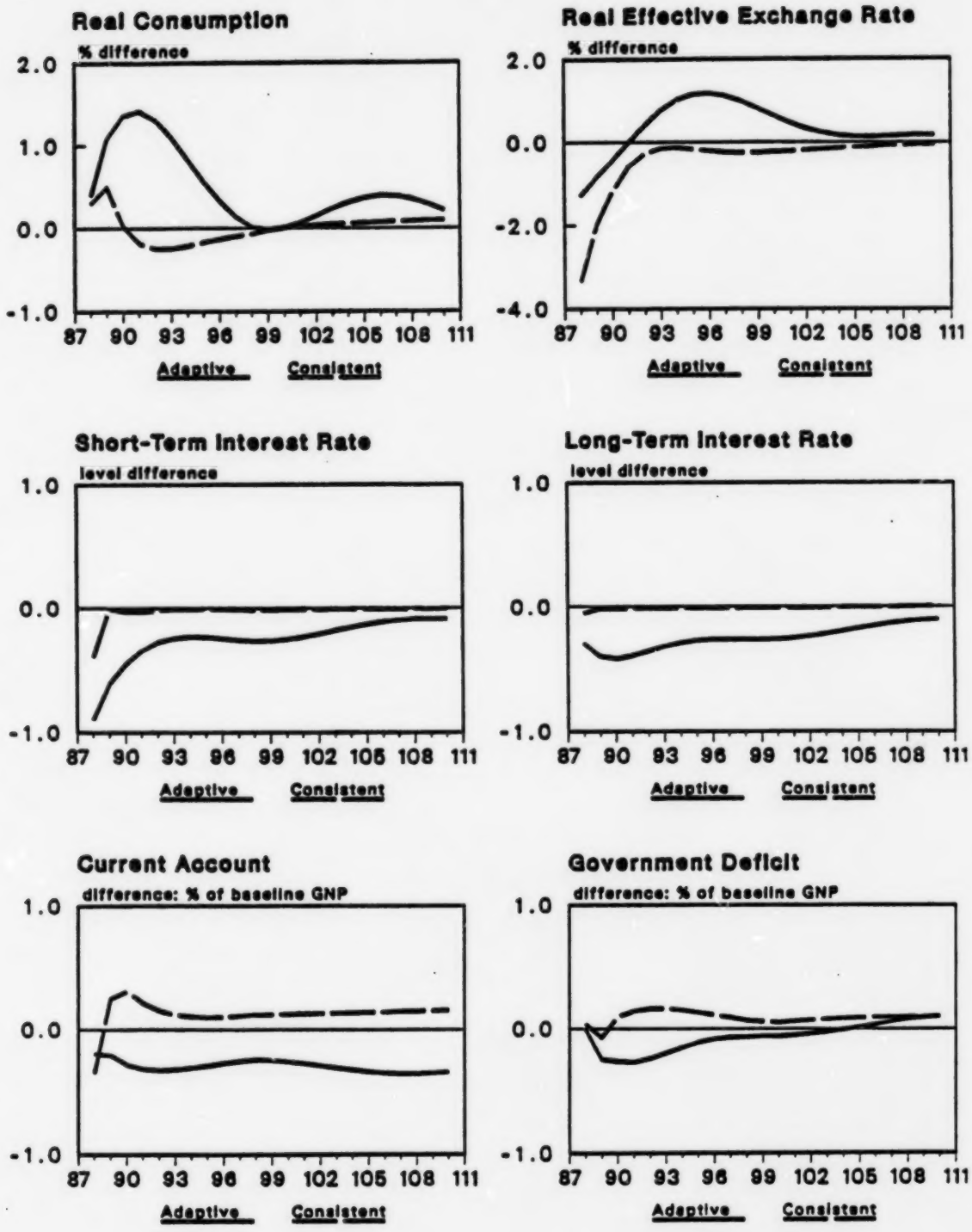


Chart 3.3(b)
Responses to a Permanent Increase in the Money Supply:
3 Per Cent of Baseline Money Supply



lagged effects of interest rate and exchange rate movements, the stimulus to output is of much shorter duration under consistent expectations, as the more rapid adjustment of the price level to its new equilibrium has the effect of quickly reversing both the downward movement in the short-term interest rate and the real depreciation of the domestic currency. After four years, the price level is very close to its long-run equilibrium level and output is slightly below control. Under adaptive expectations, output rises in both years 2 and 3 of the shock, reflecting the slower adjustment of the price level. Output remains above control for seven years following the initial shock, and the price level does not approach its new equilibrium until 1996. While the cycle generated by the money level shock under adaptive expectations is more damped than in the case of the fiscal shocks, it is nevertheless much larger than that associated with consistent expectations.

3.4 Money Growth Shock

The effects of a 1 per cent per year increase in the rate of money growth are shown in Charts 3.4(a) and 3.4(b). It is important to note that the adaptive-expectations version of the model does not give "sensible" results with respect to this shock (from a neoclassical point of view, in any event). The problem is that the initial decrease in the long-term real interest rate increases the capital stock and thus potential output to the extent that inflation does not constantly increase in spite of the fact that observed output is always above control. The model is in a perpetual disequilibrium and will blow up if the simulation is continued indefinitely.

With this caveat in mind, it is apparent that the same result is obtained with a money-growth shock as a money-level shock -- real output rises by more under consistent expectations. Again, the difference is entirely attributable to the jump in the nominal and real exchange rates in the first year of the shock. The positive shock to output lasts slightly longer than in the case of a money-level shock, but the resulting output cycle remains very damped. As indicated by the behaviour of the GNP deflator, prices lock in quickly to their new equilibrium growth path, while short- and long-term nominal interest rates rise about 100 basis points above control.[15]

4. A Comparison With Dungan and Wilson's Results

The results in the previous section on the effects of fiscal policy under adaptive versus model-consistent expectations contrast sharply with those of Dungan and Wilson using the FOCUS model. In this section we alter some of the parameters of the INTERMOD simulations to replicate as closely as possible the shocks performed by DW, in order to identify the principal reasons for the differences in results. To simplify the analysis, we

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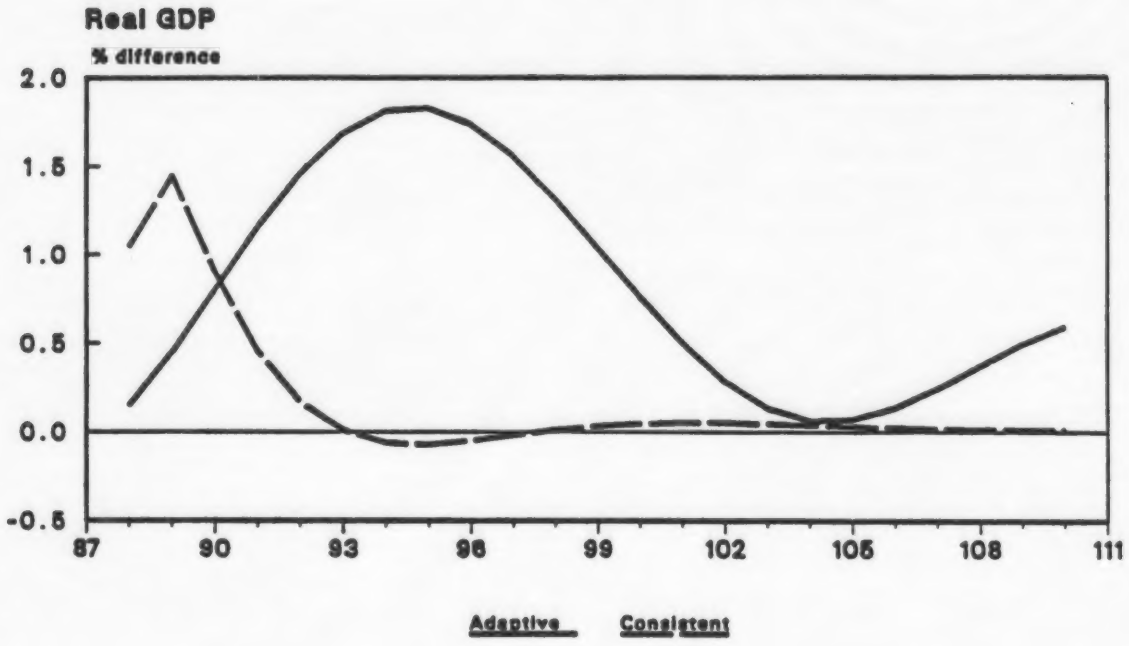
[15] The slight decline in both short- and long-term nominal rates from 1990 to 2009 under consistent expectations appears to be due to mild cycles in output and prices; this effect is reversed in the final years of the simulation.

Chart 3.4(a)
Responses to Higher Growth in the Money Supply:
1 Per Cent Per Year Increase Over Baseline Growth



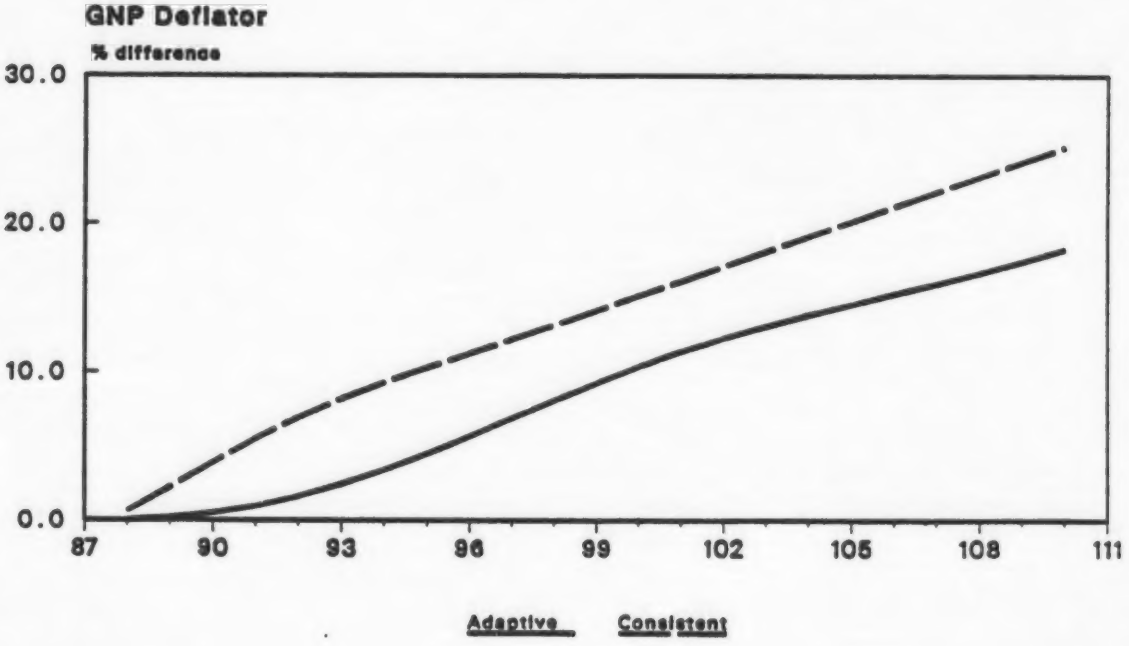
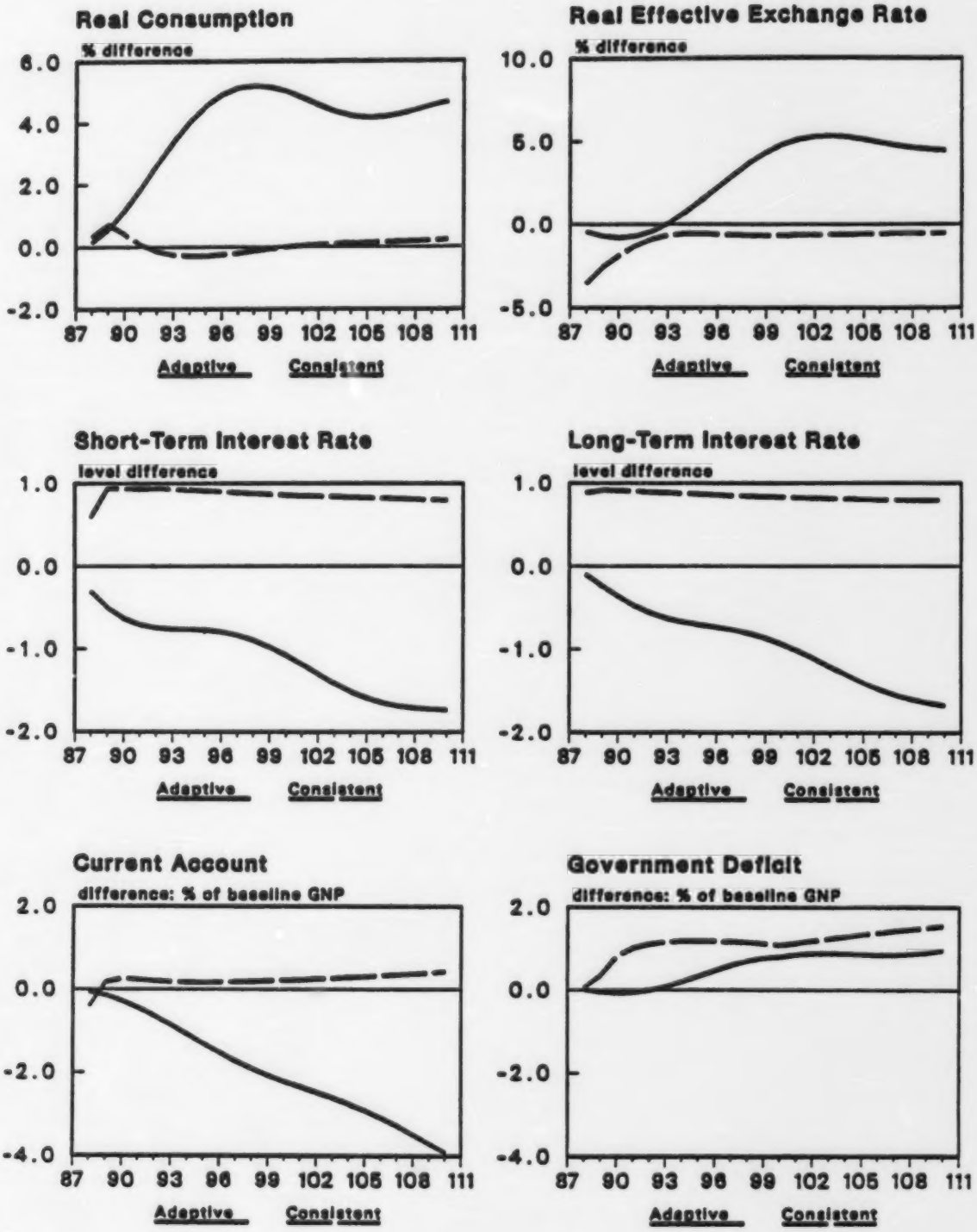


Chart 3.4(b)
Responses to Higher Growth in the Money Supply:
1 Per Cent Per Year Increase Over Baseline Growth



concentrate on the results for the government spending shock; the results for the tax shock are similar.

4.1 Simulation Horizon and Policy-Reaction Function

Two features of the DW study that are responsible for differences vis-à-vis the results presented above are the length of the horizon used to perform the consistent-expectations simulations (10 years in the case of DW versus 32 years in the case of INTERMOD), and the absence of a policy-reaction function describing the future behaviour of taxes following a government spending shock. To investigate the importance of these factors, we truncate the horizon for the forward-looking simulations in INTERMOD to 10 years, and "turn off" the tax-reaction function so that the tax rate is exogenous throughout the simulation.

These results are compared with those obtained for the standard version of the model in Chart 4.1 (detailed results for the shocks are presented in Appendix B). It is apparent that there are no first-year changes in the adaptive-expectations multipliers. This is to be expected, given that the length of the simulation horizon has no impact under adaptive expectations, and the tax-reaction function only comes into play after the first year. Over the medium-term horizon, the fact that the tax rate is exogenous means that the multiplier remains positive longer in this shock than previously, while prices rise correspondingly higher above control. Under consistent expectations, the impact multiplier is lower in this simulation than was the case previously. This is somewhat counter-intuitive given that the absence of the tax-reaction function means that private-sector wealth rises instead of falls given the government spending increase.[16] The explanation is that the effect of higher wealth is stronger beyond the initial period than on impact given the partial adjustment of consumption to wealth changes. The aggregate demand effect of higher wealth beyond the first years of the shock pushes up output, prices, and short-term interest rates over the medium term. These effects are reflected in the initial period in the form of a greater appreciation of the exchange rate. Thus a small positive effect on current-period consumption from higher wealth is more than offset by greater crowding out of the trade sector by a larger jump in the real exchange rate. This effect is reversed after the first year, but it is not until the seventh year of the shock that the effect on output under consistent expectations exceeds that under adaptive expectations.

It is important to note that this choice of simulation horizon is not consistent with full convergence of the forward-looking simulation algorithm given conventional convergence criteria. In the terminology of Fair and Taylor, extending the horizon for the type II iterations by one year from 1997 to 1998 has a non-trivial effect on the initial-period results. This is illustrated by the behaviour the GNP deflator in the lower graph -- it is

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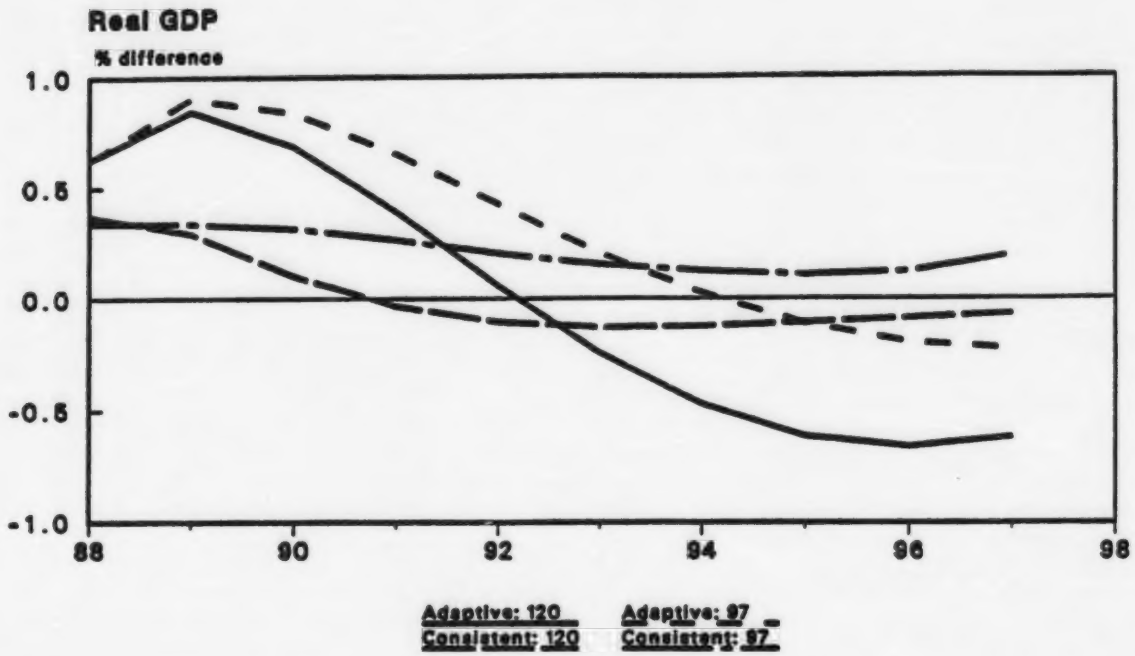
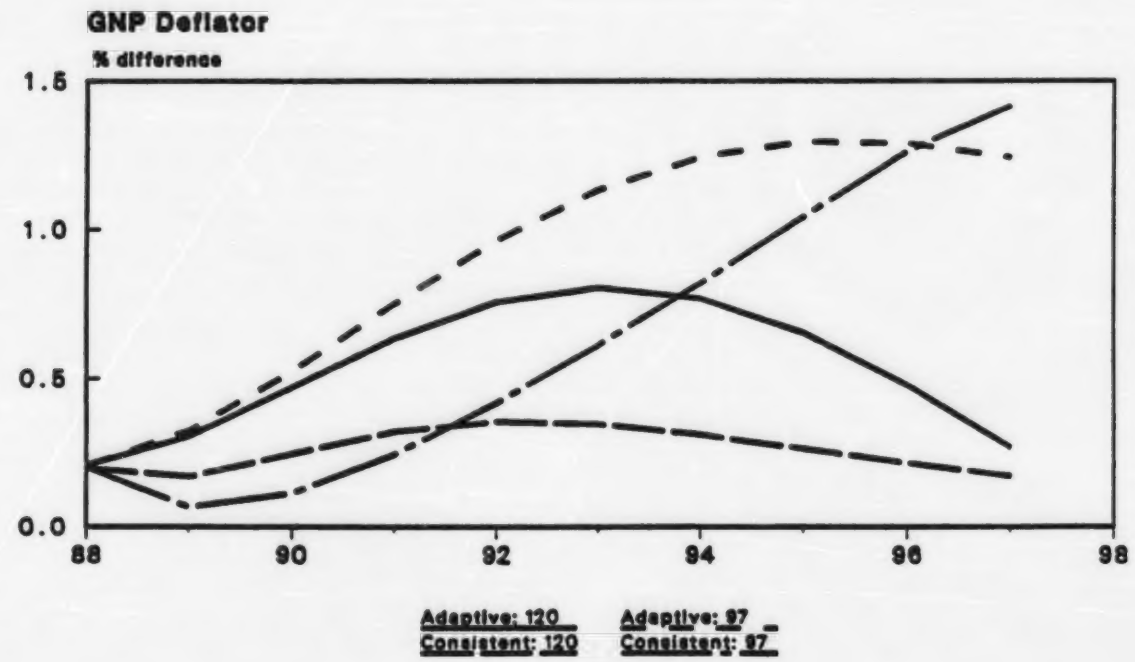
[16] This is reflected in government debt that explodes relative to GDP -- the debt-to-GDP ratio rises by about 11 percentage points over the 10-year horizon of the shock.

Chart 4.1
Responses to Government Spending Increase:
Simulation to 1997 Versus 2020, No Tax Reaction Function





apparent that inflation is not close to zero by the end of the simulation horizon, as would be required for full convergence of the algorithm.

4.2 Imperfect Asset Substitutability

Another difference between FOCUS and INTERMOD is the assumed degree of international capital mobility. INTERMOD assumes perfect mobility, thus the domestic interest rate adjusted for expected exchange-rate movements is always equal to the U.S. interest rate. This implies that a fiscal expansion will generally result in an exchange-rate appreciation given the upward pressure on domestic interest rates -- the initial-period jump in the exchange rate generates expectations of a future exchange-rate depreciation. In FOCUS, there is a flow specification of international capital movements such that the gap between domestic and foreign interest rates is a function of the current account deficit. In this framework, the direct effect of a rise in government spending is to raise imports and cause a deterioration of the current account. If the increase in domestic interest rates given the rise in spending is not sufficient to attract the necessary capital inflow, the exchange rate must depreciate to be consistent with balance of payments equilibrium. In the government spending shock performed by DW, the exchange rate depreciates by 0.71 per cent in the first year under adaptive expectations and by 1.60 per cent under consistent expectations.[17]

Our initial attempt to introduce a flow specification of international capital immobility into INTERMOD was to put the current account deficit as a proportion of GDP directly into the equation for the differential between domestic and foreign interest rates adjusted for exchange-rate movements. This was not successful because of the J-curve effect of exchange-rate changes in the model. In particular, an exchange-rate depreciation causes a current account deterioration as opposed to improvement on impact, thus the exchange rate must rise instead of fall in the first year to clear the balance of payments given a spending increase. This problem can be resolved by basing the interest-rate differential on next-period's current account balance. However, this gave much smaller effects on the initial-period jump in the exchange rate than in FOCUS, and indeed the exchange rate still appreciates in INTERMOD even given a relatively high degree of capital immobility.[18]

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[17] One reason that this exchange-rate depreciation appears to be necessary in FOCUS is the relatively small rise in domestic interest rates given the fiscal shock -- the 90-day paper rate rises by only 17 and 29 basis points respectively. This, in turn, reflects very little movement in prices in the first year in spite of the output increase and the exchange rate depreciation.

[18] I.e., a deterioration of 1 per cent of GDP in the current account balance is associated with a 100 basis point rise in the yield differential. There appear to be two reasons why the effect is smaller in INTERMOD: (i) as the initial-period exchange rate appreciation is reduced, both prices and interest rates rise by more, and (ii) as the exchange rate falls, the expected future depreciation is reduced thus

To avoid these problems, and instead highlight the responses of INTERMOD assuming an exchange rate depreciation of the same magnitude as in FOCUS, we adjust the constant term in the exchange rate equation by the amount necessary to give a roughly equivalent depreciation as in FOCUS on impact. The exogenous adjustment to the arbitrage condition is equivalent to an increase in Canadian short-term yields of 100 basis points for the duration of the simulation. This leads to an initial-period decline of 0.77 per cent in the exchange rate under adaptive expectations, and of 1.78 per cent under consistent expectations.

The effects of this adjustment on the behaviour of real output and prices given the standard government spending shock are shown in Chart 4.2. It is apparent that the exchange rate depreciation has a significant effect on the initial-period multipliers. In particular, the consistent-expectations impact multiplier is raised to 0.98, slightly exceeding the adaptive expectations value of 0.90. By the second year of the shock, however, the ordering is reversed and output deviations are larger under adaptive expectations.

This shock demonstrates that a sufficiently large increase in the differential between Canadian and foreign yields in response to a government spending shock can reverse the normal relationship between fiscal multipliers under adaptive and consistent expectations. However, the degree of imperfect asset substitutability necessary to achieve this result is inconsistent with the stylised facts (see Boothe et al. (1985)). An interesting question, then, is why foreign-exchange markets sometimes react negatively to news of stimulative fiscal policies. One possibility is that exchange-market analysts may base their reaction to a fiscal expansion on its effects on inflation, import demand, and the long-run depreciation of the dollar necessary to finance a higher stock of external debt conditional on a given short-term interest rate differential. The implicit expectation is that the monetary authorities will accommodate the fiscal expansion by not allowing the differential between domestic and foreign interest rates to rise, as would normally occur if the money supply were exogenous.

We simulate this type of scenario by assuming a policy of joint fiscal and monetary expansion, where the latter holds short-term interest rates constant in the initial period in spite of higher output and prices. As expected, this results in a small initial-period depreciation of the nominal exchange rate of about 0.1 per cent (the results are presented in Appendix B). The initial-period multipliers on real output are closer than in the absence of monetary accommodation, at 0.77 under adaptive expectations and 0.69 under consistent expectations. This is to be expected given that we are simulating a compound fiscal/monetary shock. In any event, this type of joint fiscal and monetary expansion appears to us to better explain the possibility of an exchange rate depreciation in response to fiscal stimulus than does a low degree of international asset substitutability.

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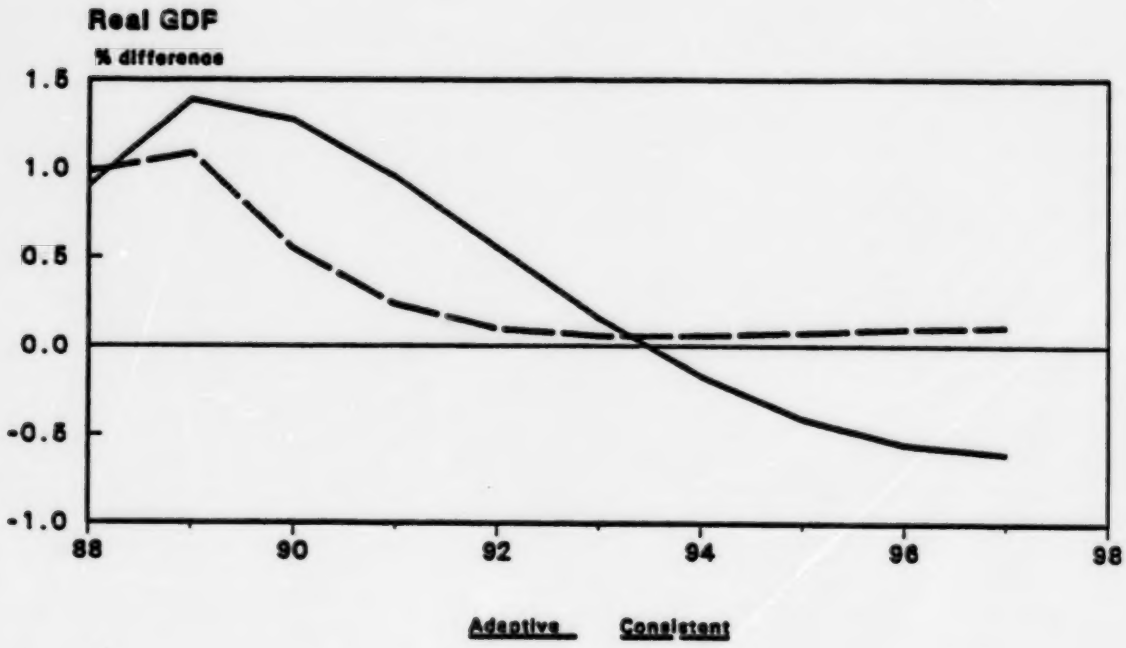
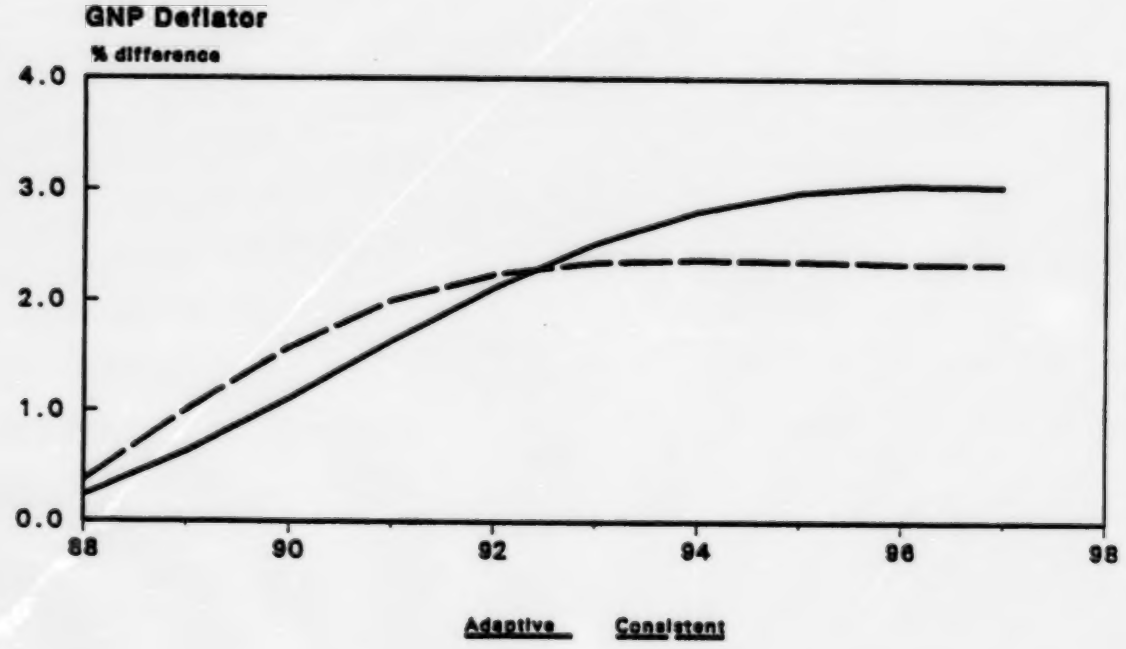
raising the effective yield on Canadian assets.

Chart 4.2
Responses to Government Spending Increase:
Initial Exchange-Rate Depreciation





5. Conclusions

In this paper we have explored the responses of the Canadian block of a simulation model of the world economy to a variety of policy shocks. Particular attention has been focused on the behaviour of output when expectations are adaptive as opposed to being consistent with the future simulated values of the model. We find that the initial effects on real output of a fiscal expansion are higher when expectations are adaptive, whereas monetary policy shocks have greater effect when expectations are model-consistent. The principal reason for the difference is that the initial-period "jump" in the exchange rate under consistent expectations tends to offset a fiscal stimulus but reinforce a monetary stimulus.

These findings contrast with the result of Dungan and Wilson that fiscal policy multipliers are smaller when expectations are model-consistent. The principal reason for the difference is that the real exchange rate appreciates in INTERMOD given a fiscal expansion, as there is incipient upward pressure on domestic interest rates from higher spending and prices; this effect is amplified by consistent expectations. In contrast, the real exchange rate in FOCUS depreciates following a fiscal expansion, given the increase in the rate of return on domestic assets needed to finance the current account deterioration under the assumption of imperfect asset substitutability. In our view, the yield differential needed to generate such a result in INTERMOD is unrealistic. There are other reasons, such as the potential monetary accommodation of a fiscal shock, that explain why the reaction in exchange markets to a fiscal expansion may be negative. An important policy implication of these results is that forward-looking behaviour on the part of the private sector will tend to attenuate as opposed to amplify the effects on real output of fiscal initiatives.

The results described in this paper are specific to the particular structure of our simulation model, and further work will be necessary to judge how robust these results are to changes in model structure. Nevertheless, it is interesting to note that the conclusions reached here concerning the effect on real variables of fiscal policies have obtained in a number of different versions of INTERMOD since the beginning of the model development exercise in 1987. While a similar "nesting" of expectations regimes is not possible with most other models, a comparison of simulations of U.S. fiscal shocks with forward-looking and more traditional macro models supports the conclusion reached here about the impact of fiscal policy on real output under different expectations regimes.[19]

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[19] This observation is based on the data presented in Table A-1 of Bryant et al. (1988). The average first-year multiplier for the 5 models with consistent expectations is 0.83, compared to average multiplier for the seven adaptive-expectations models of 1.39.

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Appendix A

Comparison of Canadian and U.S. Responses to Policy Shocks

The impact of a fiscal stimulus on real output depends not only on the expectations regime, but also on the size of the traded-goods sector relative to the overall economy and the impact on foreign activity of the domestic stimulus. The purpose of this appendix is to compare the first-year effects of a government spending shock on the Canadian and U.S. blocks in the model to illustrate the importance of these two factors. Specifically, the U.S. has a significantly smaller traded-goods sector than Canada, reducing the external leakage of a fiscal stimulus. In addition, the size of the U.S. traded-goods sector relative to the world economy is larger than Canada's, which should induce a greater increase in foreign output given a U.S. fiscal shock, reinforcing the effect on the U.S. fiscal multiplier.

The model responses are summarized in Table A.1, where "linked" refers to simulations that have been performed with all country blocks endogenous, and "unlinked" refers to simulations of the individual country blocks with the rest of the world exogenous. All of the simulations have been performed using consistent expectations. Looking first at the two unlinked simulations, it is apparent that the fiscal multiplier is considerably larger in the U.S. than in Canada. This is primarily due to the relative size of the traded-goods sector in the two countries -- in the U.S., traded goods are about 10 per cent of GDP, whereas in Canada they account for 25 per cent of output. Thus the deterioration in the real trade balance only reduces U.S. GDP by about 0.2 per cent on impact, while the impact is about 0.6 per cent in Canada. The effect of this difference on the total multiplier is magnified by the induced response of disposable income, with a slight additional stimulus coming from higher investment.

Comparing the unlinked to the linked simulations for the two countries, it is apparent that endogenizing the rest of the world raises the U.S. multiplier, as expected, although the effect is not dramatic. The most significant difference is that the effective exchange rate rises by less than one-half as much in the linked simulation, reflecting the rise in foreign interest rates following the U.S. fiscal shock. The reduced exchange-rate effect and higher activity abroad cause U.S. real exports to rise slightly, in contrast to the decline observed in the unlinked simulation. Partially offsetting the smaller decline in the real trade balance are higher interest rates both abroad and in the U.S. when the rest of the world is endogenized. This contrasts with the implicit assumption in the unlinked simulation that the supply of capital from abroad is perfectly elastic at the interest rate in the control solution. This illustrates the fact that taking account of the rest of the world has both positive and negative effects on the U.S. fiscal multiplier -- the trade balance is generally stronger, but consumption and investment are negatively affected by the rise in world interest rates.

The Canadian multiplier is also higher in the linked simulation, but the difference is even smaller than in the case of the U.S., rising from 0.37 to 0.41. The dynamics are also essentially the same -- the exchange rate

appreciation is reduced in spite of a somewhat larger initial-period rise in interest rates. This reduces the crowding out coming from the trade sector, but also has a slightly restrictive effect on domestic aggregate demand.

Table A.1

Responses of Canadian and U.S. Economies to a Fiscal Shock: Increase in Real Government Spending of 1 Per Cent of GDP

	U.S. Unlinked	Canada Unlinked	U.S. Linked	Canada Linked
Real GDP*	1.17	0.37	1.27	0.41
Real Disp. Income* . .	1.50	0.70	1.55	0.68
Real Wealth*	-1.16	-1.27	-1.06	-1.64
Real Exports*	-0.53	-0.31	0.04	-0.16
Real Imports*	2.37	2.19	2.35	2.00
GNP Deflator*	0.23	0.20	0.26	0.20
Effec. Exchange Rate* .	1.45	0.76	0.62	0.52
Short-term Int. Rate**	0.49	0.11	0.57	0.16
Long-term Int. Rate** .	0.15	0.05	0.23	0.09

* Per cent difference, shock-minus-control.
** Percentage point difference, shock-minus-control.

Appendix B

Details of the Policy Shocks Under Adaptive and Consistent Expectations

Table 3.1: Increase in Real Government Spending of 1 Per Cent of Baseline GDP

Table 3.2: Initial-Period Decrease in Average Tax Rate of 2 Percentage Points

Table 3.3: Permanent Increase in the Level of the Money Supply of 3 Per Cent

Table 3.4: Permanent Growth-Rate Increase of the Money Supply of 1 Per Cent Per Year

Table 4.1: Government Spending Shock With Horizon Truncated to 1997 and Tax-Reaction Function Turned Off

Table 4.2: Government Spending Shock With Initial Exchange-Rate Depreciation

Table 4.3: Government Spending Shock With Monetary Accommodation

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